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ABSTRACT

Using interviews with teachers and principals and a standard experimental design, this study examined the effects of class size on student achievement in mathematics and mother tongue language skills. Subjects were 610 Sri Lankan fourth graders in 18 classrooms varying in size; classrooms sizes were 20-30, 31-40, and 41-50 students. Student achievement was measured through the employment of pre- and post-tests. The instructional period was 12 weeks; teaching materials and methods were controlled across classrooms. Results showed some statistically significant differences in achievement among the different class sizes. However, these differences followed no set pattern and demonstrated no overall effects of class size on achievement. Interviews with principals and teachers suggested that differences in achievement might be more often related to a student's socioeconomic status, to possible scarcities of education resources, and to teachers' attitudes and personalities rather than to class size. (Contains 33 references.) (JW)

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Running head: CLASS SIZE AND STUDENT ACHIEVEMENT

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Class Size and Student Achievement in Sri Lanka

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Abstract

This study examined effects of class size on students' achievement in Sri Lanka. The sample represented 610 fourth grade students from 18 classrooms in schools which comprised of three categories of class sizes: 20-30, 31-40, and 41-50. Students' achievement was measured by pre-test and post-test method in Mother tongue and mathematics. Twelve-week-long scheme of work was assessed. Content materials and teaching methods were controlled. Descriptive statistics and t-tests were employed to analyze data. Findings revealed that the class size had no statistically significant effect on students' achievement. To improve students' academic achievement, principal and teacher interview data suggested making provision for better classroom facilities, more learning resources, appropriate teaching material and effective instructional practices.

Class Size and Student Achievement in Sri Lanka

Effects of class size on students' academic achievement and significance of class size in relation to student achievement have been two major issues which concerned educators in recent years. Since the 1960s researchers have been debating what the appropriate teacher pupil ratio would be for students to gain higher achievement levels. Past research showed that reduction of class size increased students' academic achievement (Butler & Handley, 1989; Sava,1984). In their four-year longitudinal class size project, Word et al. (1990) found that students in smaller classes gained significantly higher scores in reading and mathematics. Students in early primary grades achieved higher achievement scores when they were in smaller classes (Farr, Quelling, Bellel, & Johnson, 1987; Swan, Stone & Gilman, 1987; Whittington, Bain, & Achilles, 1985). Sava (1984) proposed that class size must be reduced especially in the primary grades. Smith and Glass in their meta-analyses on class size with nearly 80 studies, involving more than 900,000 students concluded that as class size decreases, achievement increases, particularly when student teacher ratio falls below 20:1; only a small difference was found between classes of 20-40 students (Glass, Cahan, Smith & Filby, 1979).

However, studies by Hallinan and Sorensen (1985) and Tomlinson (1988) indicated that class size had no significant

effect on student achievement. The way teachers handled classroom responsibilities had an effect on student's achievement: With small classes teachers had more time to work with small groups (Mitchell, 1989). Efficient class sizes were products of many variables such as the nature of learning, instructional materials and methods used, subject area taught and number of students in the class room (Cacha, 1982). Varble (1990) who studied 10 sets of data involving over 2,000 first grade classes, where class size ranged from 4 to 43, found that reducing class size is not sufficient to increase achievement scores. She pointed out the importance of teaching methods on students' achievement.

Slavin (1990), referring to his earlier work (Slavin, 1989), discussed the current state of the debate and produced evidence on the achievement effects of class size. He discussed the issue of class size and student achievement highlighting three recognized studies: The Glass and Smith meta-analysis (1982), the Educational Research Service reviews (1978), and the Tennessee class size studies (Word, et al., 1990). He found that achievement in small classes was higher than in larger classes, but these differences were small to moderate in size. Even though smaller class size effects were comparatively smaller, they had their cumulative effects over long periods of time, at least 12 years (Michell, Carson & Badarak, 1989). Summarizing the results of the longitudinal studies, Slavin showed that the long-term effects diminished over periods from three to six years (Slavin, 1990). A study conducted by Larkin and Keeves (1984) in

Australia explained the relationship between students' final achievement score and several other predictor variables including class size.

For the last fifty years UNESCO has attempted to bring teacher pupil ratios to a satisfactory level in developing countries (UNESCO, 1983). The UNESCO statistical analysis of teacher-pupil ratio concluded that in most of the developing countries teacher-pupil ratio was larger than 30:1 and some cases the ratio rose to be as high as 60:1 (UNESCO, 1988). The Sri Lankan government educational circulars stated that there was a 30:1 teacher student ratio for primary grades (Ministry of Education, 1978, 1981, 1983). Although this ratio was stated in black and white, practically in most of the classrooms the teacher pupil ratio rose far beyond this expectation.

Research related to Sri Lankan students' academic achievement bears evidence that low socio-economic status and scarcity of educational resources are major factors which affect poor achievement levels (Ariyaratna, 1987; Fernando, 1985; Gunawardana, 1982; Jayasekara, 1977; Kularatna, Dharmadasa & Dharmawardana, 1990; Siriwardana (1982); Tilakaratna, 1981). Is class size a strong factor which affects students' achievement in Sri Lanka? No profound contributions were made in research fields to find an answer to this question. Research findings from other countries (Butler & Handley, 1989; Farr, Quelling, Bellel, & Johnson, 1987; Sava, 1984; Swan, Stone & Gilman, 1987; Word, Achilles, Bain, Folger, Johnston & Lintz 1990; Whittington, Bain,

& Achilles, 1985) focused on the importance of the relationship between class size and student achievement. Class size and students' achievement appeared an important issue that needed attention by Sri Lankan educators as well as researchers if they were concerned with improving achievement levels of Sri Lankan students.

Based on this background it was of importance to investigate the issue of the effects of class size on the academic achievement of Sri Lankan students. The main purpose of this study was to examine the kinds of effects that class size had on students' academic achievement. Further objectives of the study were to investigate the nature of the effects of small classes on students' academic achievement, the nature of effects of larger class sizes on students' academic achievement and the nature of effects of class size on students' academic achievement in different subject areas.

Method

Subjects

The sample represents fourth grade students (N = 610) from 18 classrooms from three types of schools in the educational district of Kandy, Sri Lanka: Primary (schools with grades from 1-5), Kanista (schools with grades from 1-10) and Maha Vidyala (schools with grades from 1-13). The classes were selected primarily according to three categories of class size: 20-30, 31-40 and 41-50. The upper (50) and lower (20) limits of class

sizes were demarcated on the basis of class sizes in most of the schools in the District of Kandy.

Measures

Achievement in mother tongue and mathematics were measured to examine effects of class size on student achievement. The Pre-test and post-test method was used to measure gains in children's achievement scores. Interviews were used to gather principals' and teachers' perspectives on effects of class size on students' academic achievement.

Instruments

Achievement tests, marking schemes and interviews were developed for the study by a group of primary education professionals. In Sri Lanka, as standardized achievement tests were not available, teacher-made tests were constructed closely following the 4th grade mother tongue and mathematics curriculum guides (Ministry of Education, 1989). A pilot study was conducted to test the validity of the language and mathematics achievement tests, and necessary adjustments were made.

Procedure

A group of 18 primary teacher certificated teachers were chosen to implement designed curriculum. Each teacher was assigned to teach both subjects: mother tongue and mathematics in each selected class. To control for the difference in approach to teaching, they were instructed to follow the same method of teaching. Teachers were given intensive training on use of teaching strategies and time and in making lesson plans for the

two subjects separately before commencement of the program by two teacher educators in primary education under the supervision of the researcher.

Pre-tests were administered to the children prior to the intervention program by the researcher. Teachers taught the designed scheme of work for twelve weeks as planned. Teachers were interviewed individually to check for the consistency of their teaching approaches, post-tests were administered to the children at the end of the intervention program by the researcher. Mother tongue and mathematics answer scripts were marked following the panel marking procedures by a group of 12 teachers trained for the purpose. Reliability assessments were conducted to measure consistency of the marking by 12 teachers and the reliability was found to be .90 in all cases. Marking was guided by marking schemes especially prepared for the purpose.

Principal and teacher interviews were conducted by the researcher during the first two months of the program.

Method of Analysis

Data analysis was conducted in three parts in this study with the intention of getting a micro understanding of the effects of class size on students' academic achievement. Part 1 contained analysis of post test scores. Part 2 conta.ned analysis of gain scores. Descriptive statistics and t-test statistics were employed to analyze student's achievement scores in Mother tongue and mathematics (Ferguson, 1981). A qualitative approach was adopted in the collection and interpretation of interview data.

Results

Part 1

Means and standard deviations of post-test scores for Mother tongue and Mathematics for the whole sample at three levels of class sizes are presented in the table 1.

Insert Table 1 About Here

Statistics were derived from data gathered from subjects (N=534) in Mother tongue and subjects (N=546) in mathematics.

Table 2 reports the statistical significance of the data related to post-test scores of mother tongue at three different levels of class sizes in the whole sample.

Insert Table 2 About Here

Table 2 indicates a statistically significant difference in achievement in Mother tongue for a class size of 20-30 compared with a class size of 31-40, favoring the small class size, $t(30) = 5.26$, $p < .01$. Also there is a statistically significant difference in achievement for a class size of 31-40 compared with a class size of 41-50, favoring the larger class size, $t(40) = -6.42$, $p < .01$. There was no statistically significant difference in achievement when the class size of 20-30 was compared with the class size of 41-50.

Table 3 reports the statistical significance of the data related to post-test scores of mathematics at three different levels of class sizes in the whole sample.

Insert Table 3 About Here

Table 3 indicates that there is a statistically significant difference in achievement in mathematics for a class size of 31-40 compared with a class size of 41-50, favoring larger class sizes, $t(40) = -3.47$, $p < .01$. There are no statistically significant differences indicated in achievement when the class size of 20-30 was compared with the class size of 31-40 and when class size of 31-40 was compared with class size 41-50.

Part 2

Table 4 presents means and standard deviations of gain scores for Mother tongue and Mathematics for the whole sample at three levels of class sizes.

Insert Table 4 About Here

Statistics were derived from data gathered from subjects (N=412) in Mother tongue and subjects (N = 425) in mathematics.

Table 5 reports the statistical significance of the data related to achievement gains in mother tongue at three different levels of class sizes.

Insert Table 5 About Here

Table 5 indicates that there is a statistically significant difference in achievement gains in Mother tongue for a class size of 20-30 compared the with a class size 31-40, favoring small class sizes, $t(30) = 2.56$, $p < .05$. There is a statistically significant difference in achievement gains in Mother tongue when a class size of 20-30 was compared with a class size of 31-40, $t(40) = -5.37$, $p < .01$, and a class size of 31-40 was compared with a class size of 41-50, $t(40) = -7.76$, $p < .01$, in both cases favoring larger class sizes.

Table 6 reports the statistical significance of data related to achievement gains of mathematics at three different levels of class sizes in the whole sample.

Insert Table 6 About Here

Table 6 indicates that there is a statistically significant difference in achievement gains in mathematics for a class size of 20-30 compared with a class size of 31-40, $t(30) = 3.89$, $p < .01$, and for a class size of 20-30 compared with a class size of 41-50, $t(40) = 4.23$, $p < .01$, in both cases favoring smaller class sizes. There is no significant difference indicated in achievement gains when a class size of 31-40 is compared with a class size of 41-50.

Information gathered from the principals and teachers by means of interviews highlighted some of the important factors related to the issue of effects of class size on students' academic achievement.

Discussion

When looking at all the analysis conducted with post-test and gain scores in this study, statistics show no consistency between the effects of smaller classes and larger classes on students' academic achievement. The means and standard deviations of post test scores related to Mother tongue and mathematics indicated no specific characteristics related to class size and achievement. The means and standard deviations of the gain scores, reported in table 4 also do not show any patterns concerning effects of class size on students' achievement.

Further, the study examined the statistical significance of class size on achievement under a total of 12 comparisons as indicated in tables 2, 3, 5 and 6 which allowed me to identify micro aspects of effects of class size on student achievement. Mother tongue achievement was examined under a total of 6 comparisons indicated in table 2 and table 5 to test their statistical significance. Out of six comparisons, two are in favor of small classes, three are in favor of larger classes and one shows no difference. The mathematics achievement was examined under a total of 6 comparisons indicated in the table 3 and table 6 to test their statistical significance. Out of six comparisons,

two are in favor of small classes, one is in favor of larger classes and three comparisons indicate no differences. When all 12 comparisons, are considered we find that four are in favor of small classes, four are in favor of larger classes and four comparisons indicate no differences. Comparing the results of the two separate analyses it does not show any specific recognizable pattern related to effects of class size on achievement.

Comparing the results subject-wise in achievement gains indicated in the table 6, we see that smaller classes have gains over bigger classes but analyses of post-test scores indicated in the table 3, does show that larger class are higher in achievement over small classes. However, there may be a potential in the subject of mathematics that children may perform better in small classes. Butler and

Handly (1989) evidence that with the reduction of the class size significant differences can be seen in mathematic scores of first graders but not the second graders. When considered a total of 6 comparisons conducted related to mathematics scores indicated in the table 3 and table 6, only two comparisons favor small classes. The result does not show sufficient subject-wise differences related to effects of class size on students' achievement. Findings of the study reveal that the class size had no significant impact on students' academic achievement.

Principals' and teachers' interviews reveal additional evidence for the effects of class size on students' academic achievement. Varble (1990) points out that reduced class may be

necessary but it is not sufficient to increase achievement scores; teaching method may be an important factor. Principal's interviews indicate that primary school teachers are effective teachers. They organize effective teaching strategies, use effective teaching methods, and spend more time on planning. The scarcity of educational resources and limited space in class rooms have become obstacles to teachers' performance. Parents' low income is also a important factor which increases school absenteeism and it leads to decreases in students achievement.

The principals' interview indicates that teacher attitudes and teacher personality are two prominent factors that contribute to student achievement. The factors which teacher interviews indicate are almost similar to the factors indicated in principals' interview. Parents' low income, scarcity of educational resources, limited space in class rooms, students' absenteeism and students health problems, are major factors which strongly affect students achievement in schools. Overall principal and teacher interviews provide highly favorable data that suggest class size is not an important factor that affect students' academic achievement in Sri Lankan schools.

Much research from developed countries evidence that class size is a strong factor that affect student achievement (Butler and Handley, 1989; Farr, Quelling, Bellel, & Johnson, 1987; Sava,1984; Swan, Stone & Gilman, 1987; Word, Achilles, Bain, Folger, Johnston & Lintz 1990; Whittington, Bain, & Achilles, 1985). UNESCO and World bank research on developing

countries suggest that class size's effects on achievement is not so much an essential factor in education as providing facilities for better teaching (Hardad, 1978). In comparison to larger classes, small classes may reach higher levels of achievement in small amounts. Most of these situations can be seen in classes in developed countries (Dean, 1982). The study findings agree with the suggestion of the World Bank and UNESCO that effects of class size on students' achievement is not a significant factor that should be given importance in Sri Lanka, especially in primary schools.

Teachers and parents have the belief that students learn more if the student-teacher ratio is below 20:1 (Varble, 1990). The Indiana PRIME TIME project in which student-pupil ratio was 14:1 showed that after two semesters, the students exceeded normal achievement levels in both reading and mathematics (Sava, 1984). Smith and Glass (1979) in their study concluded that as class size decreases, achievement increases, particularly when class size falls below the 20:1 student-teacher ratio. In this context it may be interesting to study effects of class size on students' achievement in classrooms where student-pupil ratio is below 20:1, in Sri Lanka.

Reducing class size may provide teachers with more time for individual attention but cannot be taken as the only "vehicle" that can be used to accelerate student achievement. This study, when seen in the light of other studies related to class size in developing countries, suggests that to improve the level of

students, academic achievement it may be more important to make provision for better classroom facilities, more learning resources, appropriate teaching material, and effective instructional practices.

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Table 1

Means and Standard Deviations of Post-test Scores in Mother tongue and Mathematics by Class Size

Class Size	Mother tongue			Mathematics		
	N	Mean	SD	N	Mean	SD
20-30	120	60.8	19.4	124	43.9	30.7
31-40	186	48.1	23.7	199	41.2	27.5
41-50	228	59.6	21.0	223	49.8	25.3

N = Subjects; SD = Standard deviation.

Table 2

The t values for Post-test Scores in Mother-tongue by Class Size

Class size	20-30	31-40	41-50
20-30		5.26*	0.54
31-40			-6.42**
41-50			

*p < .05. **p < .01.

Table 3

The t values for Post-test Scores in Mathematics by Class Size

Class size	20-30	31-40	41-50
20-30		0.88	-1.85
31-40			-3.47**
41-50			

**p < .01.

Table 4

Means and Standard Deviations of Gain Scores in Mother tongue and Mathematics by Class Size

Class Size	Mother tongue			Mathematics		
	N	Mean	SD	N	Mean	SD
20-30	94	15.0	12.3	103	22.1	15.3
31-40	135	10.9	11.2	135	14.5	12.1
41-50	183	20.4	09.0	187	13.1	21.4

N = Subjects; SD = Standard deviation.

Table 5

The t values for Gain Scores in Mother-tongue by Class Size

Class size	20-30	31-40	41-50
20-30		5.56*	-5.37**
31-40			-7.76**
41-50			

*p < .05 **p < .01.

Table 6

The t values for Gain Scores in Mathematics by Class Size

Class size	20-30	31-40	41-50
20-30		3.89**	4.23**
31-40			1.08
41-50			

**p < .01.